The influence of surface water

Groundwater interactions on the shallow groundwater in agricultural areas near Fu River, China

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The influence of surface water - groundwater interactions on the shallow groundwater in agricultural areas near Fu River, China

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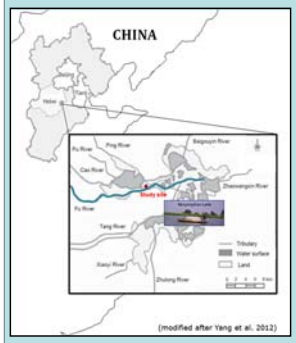
Introduction



The Northern China Plain (NCP) is known as a very important area in China for the production of maize and winter wheat. The needed application of fertilizers and pesticides can hereby have strong impacts on the quality of shallow groundwaters.

Many agricultural fields are located along waterways, which are also used for irrigation. Potential contamination between surface- and groundwater is therefore possible if a high degree of connection exists.

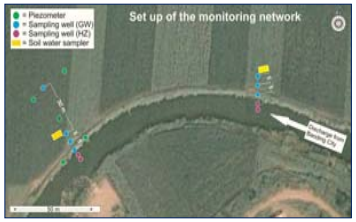
In order to assess the interaction and the risks of pollution in these specific areas, a small-scale field study was undertaken near the Baiyangdian Lake area, China, in 2013/2014.

Study aims

The aims of the study were:

- To identify flow and transport processes on site
- To assess annual changes in the system
- To obtain information about contaminant exchange between surface water and groundwater

Set-up and cross-section



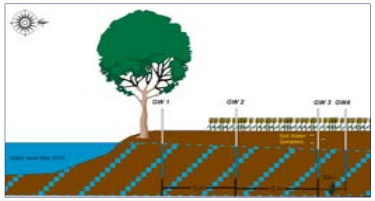
Samples

- Surface water (SW)
- Hyporheic zone (HZ)
- Groundwater (GW)
  (1, 6, 11 and 41m away from the river)
- Hyporheic zone (HZ)
- Soil water in 2 locations (SoilW)
  (0.4, 08, and 1.2m depth)

Sampling period:

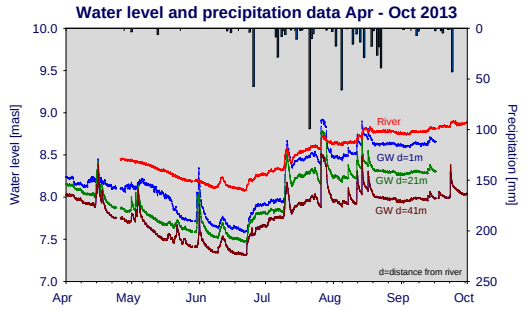
April 2013 to April 2014
(9 sampling campaigns)

Analysis:
Cations, anions & field parameters
Nitrogen species
H and O isotopes
Selected pesticides



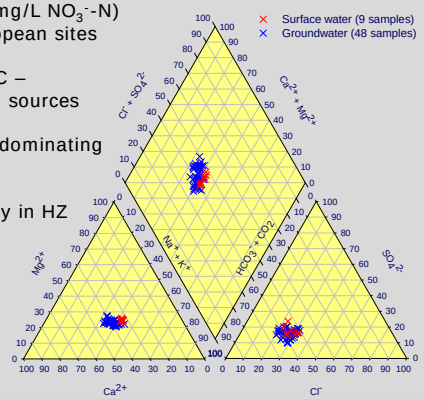
Results I – Physical interaction/water flow

- Water flow was continuously from the river into the groundwater
  (estim. vertical and horizontal flow 0.7 cm/day & 0.2m/day, respectively)
- Supported by water level, temperature, & tracer (Br) measurements



Results II – Chemical interactions

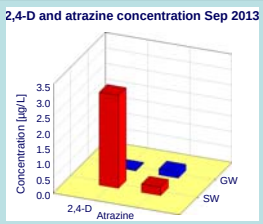
- Low nitrate levels (2-3 mg/L NO_3^--N) compared to many European sites
- Very high ion content/EC – indicates other pollution sources
- Bicarbonate type water dominating (no dominant cation)
- Reduction processes only in HZ
- SW and GW chemistry very similar, except a shift in Ca^{2+} (see piper diagram)

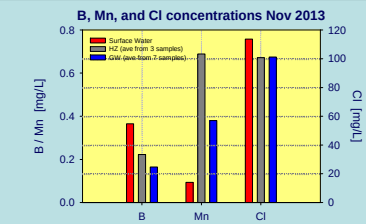


Summary and conclusion

Typical interactions found in the study are:

- Pollutants carried in by the river water (2,4-D, boron, Ni)
- Trace elements released in the HZ by redox processes (Mn, Fe)
- Pollutants & elements with similar concentration in SW & GW (atrazine, Cl)





The study showed that not local agricultural activities themselves, but the impact of the surface water causes the biggest threat to the local aquifer systems.

References: Yang, W.; Yang, Z.F; Zheng, C. (2012): Sustainable environmental flow management based on lake quality protection: The case of Baiyangdian Lake, China. In *Procedia Environmental Sciences* 13, pp. 730–741.

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